APPENDIX A

WORKSHOP REPORT

Preventing Work-Related Injury and Illness During Development and Implementation of New Environmental Cleanup Technologies

Sponsored by:
National Institute of Environmental Health Sciences
&
United States Department of Energy

George Meany Center for Labor Studies
Silver Spring, Maryland 20903

March 23-24, 1995

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PREFACE

National Institute of Environmental Health Sciences and US Department of Energy Technical Workshop

On March 23-24, 1995, representatives from labor, management, academia, and governmental agencies with expertise in the development of new environmental cleanup technologies and worker health and safety training met to discuss how to incorporate health and safety considerations into the development, field testing, and application of environmental remediation technologies to prevent work-related injury and illness and to facilitate effective emergency response planning. Held at the George Meany Center for Labor Studies, the workshop was titled "Preventing Work-Related Injury and Illness during Development and Implementation of New Environmental Cleanup Technologies." This appendix includes a summary of the activities and results from that workshop.

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Report on the Technical Workshop

AGENDA

March 23, Thursday

8:00 am	Registration - Auditorium
8:30 am	Introduction: Co-chairs George Meany Center, Welcome: Robert Pleasure, Director Opening Remarks: William Wisenbaker, Director, Office of Program Integration, U.S. DOE Workshop Purpose: John Moran
8:45 am	Panel: Agency Perspective DOE - Joseph E. Fitzgerald, Jr., Deputy Assistant Secretary, Worker Health and Safety, U.S. DOE
9:05 am	EPA - John Martin, Superfund Innovative Technology Evaluation (SITE) Program
9:25 am	DoD - Don Pittenger, Safety Engineer, U.S. Army Corps of Engineers
9:45 am	NIOSH -Joe Cocalis, Engineer-Division of Respiratory and Disease Studies, National Institute of Occupational Safety and Health (NIOSH)
10:05 am	Break
10:30 am	NIEHS Superfund Research Program-Technology Development: Dr. Joseph A. Caruso, Dean of the College of Arts and Sciences, University of Cincinnati
10:50 am	University Technology Development-Safety and Health: Lou DiBerardinis, Industrial Hygiene Officer, Environmental / Medical Services, Massachusetts Institute of Technology (MIT)
11:10 am	Review of OSHA Requirements for Informational and New Technology Programs: Earl Cook, Directorate of Compliance Programs, OSHA

11:40 am	Identification of Safety and Health Hazards Associated with CERCLA Remediation Technologies: A Comprehensive Approach: Bruce Lippy / Matthew Fitzgerald, SCIENTECH, Inc.
12:10 pm	Workshop Charge: Denny Dobbin
12:20 pm	Lunch
1:00 pm	Breakout sessions: Convene workshops (2 leaders; 1 scribe). The first task is a review by the workshops of the "General Principles and Issues" from the perspectives of their main topics.

Issue	**Leaders**	**Location**
Illness prevention	Joe Cocalis / Matthew Fitzgerald / Chip Hughes	Room A
Injury prevention	B. P. Shagula / William Bergfeld / Sharon Beard	Room B
Emergency response	Les Murphy / John Malool / John Moran	Auditorium
Implementation / training information	Carol Rice / Bruce Lippy / Denny Dobbin	Boardroom

4:30 pm	Preliminary reports back from workshop groups re: "General Principles and Issues" from each topical area. Sharon Beard
5:30 pm	Social Hour
6:30 pm	Dinner
7:30 pm	Social Hour

March 24, Friday

8:00 am	Reports back of written summations from workshop groups re: "General Principles and Issues" from each topical area. Sharon Beard
8:10 am	Break into strategy workshops

Issue	Leaders	Location
Illness prevention strategies	Matthew Fitzgerald / Chip Hughes	Room A
Injury prevention strategies	B. P. Shagula / Bill Bergfeld / Sharon Beard	Room B
Emergency response strategies	Les Murphy / John Malool / John Moran	Auditorium
Implementation / training information strategies	Carol Rice / Bruce Lippy / Denny Dobbin	Boardroom

11:00 am	Reports back from workshop groups re: "Prevention Practices and Strategies" from each topical area: Denny Dobbin / John Moran
12:00 noon	Workshop wrap-up / next steps: Discuss general plan for second workshop: Denny Dobbin / John Moran
12:30 pm	Adjourn

TECHNICAL WORKSHOP REPORT

Introduction

On March 23-24, 1995, representatives from labor, management, academia, and government agencies with expertise in new-technology development and worker health and safety training met to discuss how to incorporate health and safety considerations into the development, field testing, and application of innovative environmental remediation technologies to prevent work-related injury and illness.

The workshop was sponsored by the National Institute of Environmental Health Sciences (NIEHS), Worker Education and Training Program, Division of Extramural Research and Training, and by the Department of Energy (DOE), Office of Worker Health and Safety, Division of Environment, Safety and Health, and the Office of Program Integration, Division of Environmental Management.

Purpose

In his opening remarks, Co-chair Denny Dobin introduced the workshop as the first step in what is expected to be a multiphase process of meetings and guidance document development, the purpose of which is to reduce injury, illness, and costs associated with new environmental cleanup technologies. Guidance is to be developed by assessing such technologies from the earliest stages of their development onward, in terms of their potential to cause work-related harm. Information developed from these assessments will be used to —

- Inform technology designers so they may incorporate worker protection into the design and development of new technologies before they become operational; and
- Inform workers about the hazards to which they may be exposed.

As William Wisenbaker, who directs the Department of Energy's Office of Program Integration, EM-43, explained, DOE's interest is to ensure that worker health and safety are not neglected as the Department shifts its emphasis from weapons production to environmental cleanup. Development of innovative environmental remediation technologies is crucial to this mission transition because current technology is not adequate for the task at hand. DOE is also seeking to develop new waste management technologies that will support onsite, as opposed to offsite, disposal of contaminants.

Background

In accordance with the Superfund Amendments and Reauthorization Act of 1986 (SARA), Section 126, the Occupational Safety and Health Administration (OSHA) published worker health and safety regulations for hazardous waste operations and emergency response (HAZWOPER). Codified as 29 CFR 1910.120, these regulations include programmatic requirements that apply to training, new technology, and information management. Meanwhile, new cleanup technologies continue to be developed by DOE, the Environmental Protection Agency (EPA), and other agencies. EPA, the Department of Defense (DoD), the Air Force, and DOE have evaluated roughly 150 different remediation technologies, the results of which are available on databases such as the EPA's Superfund Innovative Technology Evaluation (SITE) Program's database and DOE's "Protech." The new technologies have been evaluated based on a wide array of criteria (e.g., startup cost, cost of operation, commercial availability, minimum contaminant levels achievable, and acceptability to local communities). Some of the databases list over 20 individual criteria for which the subject technologies were evaluated. Yet in none of the evaluations were the safety and health hazards associated with using the subject technologies included as evaluative criteria. This is disquieting in light of reports that as much as 40% of the budget of a remediation operation has been spent on ensuring a safe and healthful work environment during remediation operations.

Workshop co-chair John Moran of the DOE Office of Worker Health and Safety noted that the EPA Superfund-Labor Task Force began addressing issues surrounding the new technologies some two and a half years ago. This led to development of an EPA-OSHA agreement to conduct extensive field inspections, investigations, and analyses of these innovative technologies, culminating in development of an OSHA protocol for performing safety and health inspections of thermal destruction units for application across the cleanup industry.

Concerns about use of new technologies arose at DOE after problems began to surface in the Department's thermal destruction processes and at hazardous waste sites. The enormous cost to taxpayers of the DOE cleanup will continue to spur development of new technologies aimed at reducing costs and accelerating the pace of cleanup, Moran contended. To prevent illness and injury, it is vital, he said, that health and safety be addressed at the front end of technology development, not after use has begun.

Federal Agency Perspective—Presentation Highlights

Occupational Safety and Health Administration

Earl Cook, from OSHA's Regional Office in Salt Lake City, Utah, reviewed the requirements of paragraphs (i) and (o) of the OSHA HAZWOPER Standard (29 CFR 1910.120), which deal with information and new technology programs, respectively.

The informational program requirement states that site safety and health plans at hazardous waste sites are to direct that onsite hazards be communicated to workers in an ongoing manner. If new hazards are identified or introduced, employees must be notified within a reasonable time about what those hazards are and how to protect themselves from them.

The new-technology requirements state that any technology in use at a hazardous waste site must have its hazards characterized and its personnel trained in the safe operation of related equipment. OSHA does not regulate new technology per se, Cook said, but does regulate work practices. Within this context, for instance, OSHA might question why an employer is using an older technology when a newer method would present fewer hazards to the workforce. OSHA's interests in innovative technology have more to do with improving characterizations of employee exposure than they do with new remediation techniques. At OSHA's own laboratories, this is the focus of research underway.

Paragraphs (i) and (o) are rarely cited by OSHA. They are more likely to be used as programmatic stimuli to guide employer development of site safety and health plans. Because these paragraphs are viewed as relatively obscure, compliance officers are more likely to cite an alternate, more familiar standard to accomplish the same purpose.

Department of Energy

According to Joseph Fitzgerald, DOE's Deputy Assistant Secretary for Worker Health and Safety, Office of Environment, Safety and Health, most environmental protection specialists do not receive training in occupational health and safety, nor do they have much experience in the field. As a result, worker health and safety are often neglected. Fitzgerald has elaborated on this problem in a paper entitled “Cleanup Worker Health and Safety: Missing in the Action,” which he delivered at a recent waste management meeting.

The DOE cleanup presents an opportunity to effectively inject safety and health considerations into the remedial process. Safety and health technology development needs to be treated as an adjunct to environmental technology development and as an opportunity to advance development of safety and health protection technology in tandem with environmental control technology. This should help push some of the needed measurement and instrumentation innovations over the threshold into application, Fitzgerald said.

Another significant issue is how to integrate an analysis of the hazards a worker is likely to confront into the work planning process so that the necessary precautions can be taken up front. Fitzgerald cited several cases, such as that paraphrased below, where death or injury occurred because work planning of this type had not occurred.

- The massive Texas Super Collider project, which terminated approximately a year ago, involved building a massive 50-mile tunnel to house an accelerator. This involved digging a shallow culvert and covering it. Considerable attention focused on construction safety issues, but little on what was to be DOE’s first major use of tunnel-boring machines. The site contractor relied on a subcontractor, who had extensive experience with the technology, to actually do the boring. Despite the conventional use of such equipment, its operation and safety have not been well understood, nor was the need for training of operators and support staff sufficiently recognized. From a management standpoint, there was also too much deferral to a subcontractor. A fatality occurred within only a month or two of construction commencement. The fatality occurred when a piece of wall lining was being placed by the equipment as the machine dug forward. The injured worker was standing at a point where the piece of concrete could strike him, which it did.

A technology hazard assessment document would have warned workers against proximity to the equipment under certain operating conditions. Considering that dangers are posed even by equipment that is in widespread use, how much more dangerous will more complex and innovative equipment be? It is crucial that means be developed to convey the unique hazards of new equipment to managers and workers alike, Fitzgerald stated.

EPA SITE Demonstration and Evaluation Branch/EPA Risk Reduction Laboratory

The chief mission of the Superfund Innovative Technology Evaluation (SITE) Program is technology transfer to the user community (i.e., EPA regional offices, state and local control agencies, other Federal agencies, contractors, and the site owner community), according to SITE presenter John Martin.

Established under SARA, Section 311(b), the SITE program provides for coordinated Federal development, research, demonstration, and training in how to use alternative hazardous waste treatment technologies. SITE is also supposed to provide incentives for such technology development.

SITE has three parts: (1) an emerging technology program at the lab or pilot stage, (2) a demonstration program where technologies that are field-ready are reviewed, and (3) a measurement and monitoring program whose purpose is to devise new, more efficient evaluations of the nature and extent of pollutants at Superfund sites. Because SITE is in a position to affect the commercial future of the technologies it studies, considerable effort is expended to ensure the quality of the data collection and assessment activities performed.

As defined by SITE, innovative technologies are those for which there are not yet sufficient cost or performance data to warrant commercialization. Such innovations may include adapting a well-entrenched technology (e.g., adapting a Bureau of Mines technology traditionally used for classifying and removing minerals to washing soil).

The SITE objective is to produce three types of reliable information: engineering data to help understand how the systems operate, performance data to assess how well the given technology serves the cleanup, and cost data on how economically it performs. Because demonstrations generally last a year or less, findings are valid over the short term, but not necessarily over the long term (i.e., over periods of a decade or more).

SITE is not designed to assess whether a technology is protective of human health. In terms of quality assurance, no specific review of health and safety plans takes place, other than through regular program channels. The SITE demonstration plan includes how to evaluate the technology and perform quality assurance and sampling, but the health and safety component usually involves little more than adding vendor hazard information to the existing site safety and health plan. SITE itself does not have expertise in developing such plans.

Although innovative technologies may present exotic new hazards, many hazards that continue to be seen at hazardous waste sites are common to industrial settings (e.g., slip, trip, and fall hazards, heat stress, and, in some cases, cold). High pressures and high temperatures around the equipment are also common hazards. Martin provided the following examples of some new technologies and their potential hazards.

- *In situ* technology involving a two-zone capture of a pollutant plume underground, which is accomplished by injecting or putting in wells. Most of the actual cleanup is done underground, hence it is the surface installations that present the hazards. In many cases all that can be seen on the surface is a well head, a few pipes, and a few pressure gauges.
- *In situ* thermal technology in which soil is melted using the geo-safe process to drive off organics, incinerate the substance, and form a glass-like melt in which other inorganic pollutants can be trapped. Hazards here involve high heat below the surface and possible cave-ins. In one case, the melt came to the surface, causing liquid magma to splatter, which in turn caused all of the superstructures to catch fire.
- Lower temperature thermal processes, such as thermal absorption, of which there are various types. In one instance, thermal absorption was being applied to soils contaminated by a plasticizer. Because of site constraints, including the inability to move equipment around, numerous conveyers, thermal equipment, hot soil, and front-end loaders were congregated in a small area. The inability to see around the equipment presented a hazard.
- Biological treatment processes to treat groundwater through a submerged fixed film biological reactor. In one case the reactor was merely a series of tanks inside a tractor trailer. In another case where the reactor was located at the site of an operating lumber yard, the contaminants were being tracked outside the “hot zone.”
- Soil and debris washing during which heavy pieces of equipment contaminated by polychlorinated biphenyls (PCBs) are lifted by crane and placed into the washing unit and afterwards placed back on the ground. This creates overhead hazards.
- Removal of pollutants from groundwater and from oil pumped out of a landfill through a chemical reaction using hydrogen. Hazards may include elevated temperatures and PCB-laden seepage.
- Filtration processes such as those using reverse osmosis at high pressure. Hazards include high pressure in the canisters and lines.

National Institute of Occupational Safety and Health (NIOSH)

Joseph Cocalis, Division of Respiratory Disease Studies, NIOSH, warned that costly and serious consequences result from neglecting health and safety aspects of innovative technology. He described how a design flaw in one innovative remediation technology led OSHA to close down an operation:

- An enclosure was built around contaminated soil to protect the public from fugitive emissions. A small fan, which was the only ventilation available to equipment operators working in the enclosure, failed to prevent chemical concentrations from reaching levels that were immediately dangerous to life and health (IDLH). This forced OSHA to close the operation.

Routine operations associated with innovative technologies must also be addressed. To demonstrate his point, Cocalis showed a slide of a 46-year-old driller seen at West Virginia University Hospital in 1992 who died in 1994.

- Although the worker had not operated a drill since 1987, the lower portion of his lung had petrified and filled with sand. Drilling of the type that caused this worker's problem is common among the new technologies currently being demonstrated on Superfund sites. Some of this drilling is taking place in uncharacterized soil, which may exacerbate the hazard.

Unfortunately, the conflict between budgetary constraints and occupational health and safety is recurring in this new arena. Noting the inadequacy of ventilation within a particular enclosure, Cocalis was told that adequate ventilation would cost too much.

The NIOSH Educational Resource Centers, Hazardous Substances Training Program (which targets environmental health professionals), and Hazard Evaluation and Technical Assistance Programs are all resources that can be tapped more fully to disseminate information on the health and safety hazards associated with emerging technologies. NIOSH is participating in the EPA Superfund-Labor Health and Safety Task Force through which the agency hopes to open lines of communication and be of greater assistance where its expertise is needed.

Department of Defense/Army Corps of Engineers

DoD and the Army Corps of Engineers are trying to move from a compliance mode to a systematic or system safety mode of operating, according to Don Pittenger, Principal Safety Engineer for the Corps since 1981. Compliance is only as good as the standards in place, Pittenger said, and with regard to new technology often no validated standards exist. Those standards that do exist often have large gaps in protection.

By definition, a good design should be a safe one, Pittenger said, but increasing complexity in today's world militates against that. Other impediments to optimizing health and safety include overemphasis on "exotic" hazards, problems with identifying crucial variables and controlling them as early on in the process as possible, and failure to anticipate additional risks. A team effort — one that includes end-users and health and safety specialists — is needed to optimize safety. Adequate risk or hazard analyses should (1) identify the information needed to make decisions and (2) assess the tradeoffs they entail. Military Standard 882 involves a precedence sequence directed toward "designing the hazard out." If that can't be done, safety devices and warning devices should be added. Control through the use of procedures, training, and personal protective equipment should be the last lines of defense, Pittenger maintained.

DoD employs "safety working groups" at the early stage in an innovative technology's conceptual development. Usually, an end-user will participate. As part of a typical design process, the safety groups take the following actions.

- Discuss safety concerns up front.
- Conduct a system or subsystem hazard analysis of areas of significant concern.
- Conduct a fault tree and / or operational analysis, if merited.
- Conduct reviews of the system for its health and safety impacts as alterations are made.

A method called "Hazard Tracking Law" involves identifying and documenting hazards, identifying controls, and using the resulting information as "connective tissue" between different phases of a design project.

Incident analysis also becomes important. No matter how much early work is done, some risks and problems are bound to be overlooked. When hazardous and injurious incidents occur, they must be analyzed and corrections made to prevent their recurrence.

Ideally, if people did their jobs right, health and safety would be ensured. Usually, however, there are competing definitions of what constitutes "right." Too often the definitions do not include health and safety and, where they do, it is often not across the whole life cycle of the project or technology, Pittenger stated.

Design Stage in Innovative Technology Development

NIEHS Superfund Research Program — Technology Development

The NIEHS Superfund Basic Research Program funds 13 programs nationwide, of which the University of Cincinnati research project is one, according to Dr. Joseph A. Caruso, Dean of the Colleges of Arts and Sciences at the University of Cincinnati. The Cincinnati project in turn is composed of seven other research projects, which consist by and large of interdisciplinary research, training, and industrial and outreach programs whose aim is to reduce risk to human health through development of advanced microbial systems to degrade hazardous, environmentally recalcitrant pollutants. Besides investigating which bioorganisms are most effective in degrading contaminants, the project analysts also investigate basic molecular and genetic processes that might be applied to environmental cleanup.

Caruso described the seven research projects that Cincinnati is engaged in and the problems that have surfaced in the course of the research. One issue that has arisen is whether hazardous metals should be regulated in their entirety or whether only the "bio-available" portions of the elements should be. Scientists have also been looking at "element-specific species." For example, some arsenic is contained in seafood in an entirely innocuous form, whereas other forms of arsenic can be harmful merely if breathed. The various forms also occur in mixtures. This raises questions such as how to separate and examine a mixture's components and whether the bio-available amounts are sufficient to present a hazard.

University Technology Development — Safety and Health

Lou DiBerardinis, Industrial Hygiene Officer, Environmental/Medical Services at the Massachusetts Institute of Technology (MIT), is associated with an “in-house environmental health and safety organization” engaged in protecting personnel working on the type of research projects Dr. Caruso described. He made the point that if health and safety are addressed at the research stage—with respect to the researchers themselves and other workers—some of that orientation may carry over into the development and application of new technologies.

Founded in 1948 by Harriet Hardy, who trained under Alice Hamilton, a pioneer in the field of occupational medicine, MIT’s environmental health and safety organization is charged with protecting the environmental health and safety of the institute and has four components: (1) occupational medicine, (2) industrial hygiene, (3) radiation, and (4) bio-safety. Occupational safety is dealt with separately.

With roughly 2,500 laboratories to oversee, the department’s responsibility is to conduct “process hazard reviews.” This entails meeting with each principal investigator before research begins, obtaining information about the given project, developing standard operating procedures, and evaluating whether the facilities are adequate for the task (e.g., protection against fire and explosions is sufficient, venting is adequate). All these activities are to take place before project startup. As research begins, the review continues while equipment is built and prepared for operation. Routine inspections and exposure monitoring occur after startup.

Researcher cooperation and compliance have been problematic, DiBerardinis said. Much of the impetus driving improved practice has had to come from regulatory agencies. One of MIT’s goals is to write “standard operating procedures,” one of the regulatory requirements of the laboratory standard OSHA promulgated some 5 years ago. At MIT this has been a highly decentralized process, despite the overlap and redundancy of issues like program monitoring, medical surveillance, and emergency response. Moreover, some sectors, such as offsite research, are being overlooked altogether, DiBerardinis suspects. Another relatively neglected area is the education of researchers in procedures for safe handling of hazardous substances, such as asbestos, which they may be using in their experiments.

A Comprehensive Approach to Hazard Assessment of Innovative Remediation Technology

Bruce Lippy and Matthew Fitzgerald discussed the paper they had prepared on identification of safety and health hazards associated with hazardous waste technologies. It took nearly a decade after the Superfund legislation was passed, Lippy pointed out, before OSHA issued specific standards to protect workers in a hazardous waste environment. He was hopeful that progress would be made more rapidly with respect to innovative technologies as a result of the investigations inaugurated through this workshop. Little has been done thus far, however. Health and safety are notably absent among the various criteria used to evaluate new technologies in the various EPA matrices. The situation is similar with regard to DOE analyses.

Too often safety and health are not addressed until the very end of the work process analysis, at the point when the plan is about to be implemented, Lippy pointed out. This puts the safety and health professional in the position of seeming obstructionist rather than helpful. Hazards need to be considered further upstream and safety and health professionals need to be members of the team throughout the development process.

Matthew Fitzgerald focused on how to package safety and health information in usable forms. Proposed tools include safety hazard matrices, health hazard matrices, transition checklists, and technology safety data sheets (TSDSs). Checklists should be particularly helpful for research scientists and design engineers to use as they go through the various stages of development, Fitzgerald said. Contract clauses between remediation companies and responsible parties are another tool that could be used. Various formats and tools are needed because information needs vary at different stages of development.

Lippy and Fitzgerald said that safety and health hazards need to be broken out; hazards to safety have tended to receive less attention than have hazards to health. By introducing safety as an additional criterion, safety and health matrices make comparison possible between one technology and another in terms of both health and safety. For instance, the various technologies would be listed along the left-hand column of a matrix, and the various safety hazards one might expect to be associated with them (e.g., lockout/tagout, confined space, flammability, explosion, electrical hazard) would be listed across the top. A certified safety professional, certified industrial hygienist, design engineer, or other competent person would rate the hazards associated with the different technologies, based on some commonly accepted scale. The health hazard matrix would be similar, listing hazards such as inhalation, absorption, biohazards, noise, and ingestion. These matrices could serve as the bases for developing an information vehicle similar to the Material Safety Data Sheets (MSDSs) developed under the Hazard Communication Standard.

TSDSs are especially useful for capturing large amounts of information in a concise manner. Like the MSDSs, they could be used to identify a given technology, its applicable regulations and references, its uses and other names, emergency contacts, the contaminants and media that it is designed to treat, and the hazards associated with the contaminant media. The sheet could also be used to provide a process description with diagrams. Like the MSDSs, the TSDSs would be designed to facilitate worker understanding of the hazards associated with the given technology. A hazard ranking system such as the following could be applied:

#1 No excess hazard level (i.e., background);

#2 Elevated risk or hazard known to be present;

#3 Extremely high hazard; and

#4 Potentially IDLH.

The results of phase analysis and a list of the hazards associated with each phase should be included, as should guidance on plans and programs unique to use of the particular technology. Case studies are a powerful training tool and should be included, also.

It is imperative to distinguish among the various phases of operation because, frequently, it is in the transitions from phase to phase that incidents hazardous to health and safety occur. Hazards during transition periods could be identified using a checklist.

During discussion it was observed that TSDSs could be useful in other spheres besides environmental cleanup—and in the design as well as the implementation phase.

At the conclusion of their presentation, Lippy and Fitzgerald presented footage from EPA videotapes, illustrating a variety of hazards evident at Superfund innovative technology evaluation pilot sites. Some of the technologies and associated hazards were quite complex, while others were very basic. The hazards illustrated had to do with walking-working surfaces, elevated structures, inconsistent use of personal protective equipment, ergonomics, and poor machine guarding on equipment.

Breakout Session Summaries

Illness Prevention Issues and Strategies

Rapporteur: Matthew Fitzgerald

It appears that technology designers expect safety and health hazards to be addressed later in the process (i.e., at the demonstration and commercialization stages). On the other hand, research scientists are addressing health and safety in their own laboratories. It might be useful therefore to capture information about the ways they are protecting their own health and safety, both for the value of the information itself, and to inject a safety and health orientation earlier on in the process.

The use of checklists may facilitate the injection of health and safety considerations into the process. For example, a checklist could be formatted into a decision tree that scientists could use to work through hazard abatement procedures. In assessing a hazard such as a solvent, scientists could use a decision tree to determine whether a substitute could be used or if the solvent was regulated by OSHA, NIOSH, or the American Conference of Governmental Industrial Hygienists (ACGIH). The scientists could use the tree as they proceeded through the development process. Marshaling all available scientific knowledge about the hazards would also be invaluable. Because a great deal of toxicological data exists on substances on which no MSDSs are available, scientists need to know about alternative data sources as they move through decision trees.

Decision trees could be computerized (e.g., with prompts such as "What solvents are being used?" "What substitutes could be used?") The deliberative process employed by Food and Drug Administration research scientists might be a useful model in heightening awareness and responsibility among the technology research and engineering community.

Another idea is to look at the development of technologies through time. At the laboratory research stage, health would be the focus, since this is the stage that decisions are made about chemical use. Safety hazards arise later in the pilot, demonstration, and commercialization stages and would become the focal points then.

In implementing the safety and health hazard matrices, users should identify the regulation that applies to each hazard. This has a two-fold purpose: (1) it helps workers educate themselves further by encouraging them to request copies of the applicable standards; and (2) it provides ammunition for industrial hygienists to use with management.

TSDSs need to be written so that workers can understand each subject technology and its associated hazards.

Case studies are still another means of heightening DOE and EPA SITE attentiveness to technology hazards.

Injury Prevention Issues and Strategies
Rapporteurs: Bill Bergfeld and B. P. Shagula

Bergfeld and Shagula emphasized the importance of identifying target audiences that need to hear about the health and safety aspects of technology innovation. Scientists engaged in basic research and those who will apply that research in the design of innovative technology are one such audience. Engineers, manufacturing companies, and national laboratories are examples of others. Within these audiences are various subgroups, such as field-testing personnel who may or may not be designers, training personnel, consumers, Federal agencies, and contractors. Decisionmakers are yet another audience that needs to be informed about these issues.

The information products needed may differ from group to group. Researchers, for instance, could use chemical factsheets, sets or lists of safety and health issues, lists of databases of safety and health information, and training in professional settings such as symposia. Development of database-decision tree software could be helpful. The decision trees might differ for different research audiences. Because mechanical engineers, for instance, may not know what types of technical support they need, a decision tree could identify a range of sources, such as safety engineers, toxicologists, and epidemiologists. This might also be the first time a TSDS would come into play. Job hazard analyses might be useful to some audiences.

Information products for the consumer or user would be the completed TSDS and standard operating procedures. Other important information products include contract specifications, guidance on selecting and evaluating new technologies, quality assurance procedures, and guidance on how to employ a team approach for health and safety analysis across all phases of the project.

The TSDSs need to be comprehensive in nature, addressing both health and safety, and including room for application issues.

Bergfeld and Shagula applauded the fact that DOE is developing a limited standard on health and safety related to innovative cleanup technology.

They said that organized labor should take the lead in urging EPA as well as DOE to move this process along more rapidly and they noted that the insurance industry may be a potential ally.

Emergency Response
Rapporteur: John Moran

The emergency response group identified the following issues.

1. Minimum levels of training, equipment, and specialized gear necessary on a site-specific basis need to be identified. At most sites, the offsite emergency responders are not trained to the Title I or Title III requirements, much less appropriately equipped.
2. The guidance document developed from these workshops should devote a chapter to community emergency response needs. Communities need to know, for instance, that if they use an incinerator, large quantities of foam need to be stored onsite in the event of fire.
3. The entire emergency response community needs to be involved in the emergency response process, not just hazardous material (HAZMAT) teams. This includes other firefighters, emergency medical service personnel, and emergency medical facilities. Although HAZMAT is usually the focus, in reality some 70 to 80 percent of emergency medical calls are because of injury [not illness].
4. The guidance document should include as many case studies as possible to establish the seriousness of a given problem and the range of hazards it presents. The emergency response breakout group will be collecting such case studies for use in the initial draft of the guidance document.
5. The unique emergency response threats created by innovative technology, the unique hazards in the training, and the special training and equipment required all need to be identified. It cannot be assumed that any Title III or Level 3 emergency response group may be able to respond to all emergencies.
6. Virtually all the equipment used onsite, which emergency response personnel are introduced to during pre-incident planning, is new to them. Hence, the group recommends that TSDSs with emergency response requirements be developed for all existing remediation technology. These sheets should be a required component of all site safety and health plans.
7. Minimum standards applicable to the emergency response community need to be defined. These may include National Fire Protection

Association (NFPA) standards, Federal regulations, and others. At present, there are no minimum standards, and the capabilities of local emergency response crews vary enormously.

8. It would be useful to have an audience-keyed resource guideline list as an appendix to the guidance document or the document chapters.
9. Good, effective, early communication needs to be established with the emergency response community at the outset of site cleanup, even when current technology is being applied. Currently, 6 to 8 years are spent assessing a given site, developing and gaining approval for a record of decision, issuing a contract, hiring a cleanup contractor, and developing a health and safety plan. It is only then, generally, that the associated fire chief is apprised of what will be done.
10. Hazard analyses should focus on the Process Safety Management (PSM) standard because most innovative technology involves applying macrochemical industrial techniques on a microscale at hazardous waste sites. Extensive PSM compliance programs may apply to decision tree and other hazard analysis approaches.
11. The EPA SITE, DOE, and DoD innovative technology programs need to stipulate that a health and safety guidance document be a required element of their development and demonstration programs.
12. Different informational and technological needs among audiences must be recognized in the course of developing a guidance document.
13. Every guidance document should facilitate assessment of technology onsite today, as well as of technology developed in the future.

Implementation/Training/Information Issues and Strategies
Rapporteur: Carol Rice

This group focused on two target populations. The first was workers. In the pilot, demonstration, and all subsequent phases of technology innovation, contractual and other types of language are needed to mandate establishment of health and safety committees with membership consisting of both workers and management. Operators, maintenance people, and emergency responders also need to be represented on these committees. Participants need to be trained in working with quality circles or other structured processes to ensure incorporation of their expertise into the process.

Prior to the demonstration phase when an established workforce may not be available, lists of various resource people should be developed to enable designers to access the necessary expertise. NIEHS trainees who have completed 40-hour programs or technician-level training are appropriate candidates, as are labor health and safety representatives.

Once implemented, this consultative process needs to be ongoing so that, as new technology is introduced, the health and safety committee can review hazard assessments, as well as the appropriateness of standard operating procedures and compliance with them.

Some of the case studies of accident costs that Ruth Ruttenberg & Associates, Inc., has been developing might be beneficial to the committees, as would other case studies. In research grant applications and in contracts, language should be included requiring that health and safety expertise be used and that health and safety considerations be incorporated into the design process of new technologies.

A more fundamental approach would be to work with professional organizations, such as the American Chemical Society, as well as the training institutions. The goal would be to ensure that new designers entering the workforce consider health and safety in the initial stages of their designs. This could be fostered through interactions with the accrediting bodies of engineering schools. Attempts to add health and safety questions to Professional Engineer exams are already being made. More interaction is needed to encourage the consideration of health and safety issues at universities, where scientists and engineers are "retrofitted" for new responsibilities. The insurance industry and indemnifiers could help advance this work.

Concluding Summary
Rapporteur: John Moran, Workshop Co-Chair

Delineating target audiences and creating user-friendly means for them to access and exchange information are core approaches to stimulating consideration of health and safety in the development of innovative cleanup technologies. Most of the focus should be on innovative technology development programs, particularly those subsidized with substantial Federal resources. Producing a guidance document that will institutionalize an approach to ensuring that health and safety are integral to innovative technologies should be a prime objective. This could prevent a great deal of injury and illness and save many lives.

A draft guidance document will be developed as the product of this workshop and will be sent to all participants. Sufficient review time must be built into the process to permit Federal agency participants to obtain comments from their constituents and colleagues both inside and outside their respective agencies.

After the initial draft has been completed and, circulated, and comments have been received, an interim document will be developed to serve as the basis for the next workshop on this issue.

This workshop has been a valuable event because it is the first time that any group has come together to focus on this issue. Getting the Federal agencies such as EPA and DOE to actually apply and enforce the approaches conceived of to advance health and safety in this area will be extremely difficult and may require legislation or regulatory action. Such actions cannot be pursued, however, until a consensus is reached on the proposed guidance. The first step has now been taken toward that goal.

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APPENDIX A

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NIEHS/DOE Workshop

APPENDIXES